Jameco Part number 134105

Ultrasonic Sensor with Voltage Output

User's Guide

Jameco Part Number 134105

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Ultrasonics Overview

Introduction
Ultrasonic sensors measure the distance or presence of a target object by sensing a sound wave, above the range of hearing, at the object and then measuring the time for the sound echo to return. Knowing the speed of sound, the sensor can determine the distance of the object from the transducer element.

(1) Ultrasonic pulse transmitted

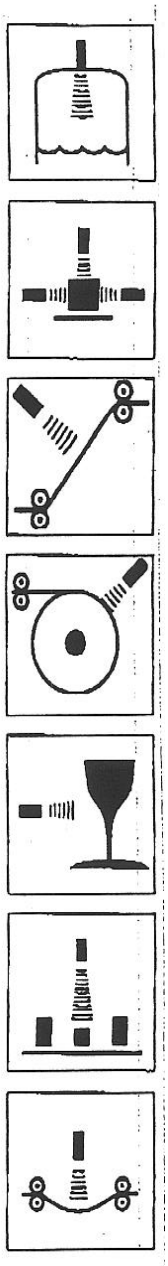
from sensor

(2) Ultrasonic echo returns from target

Advantages

- **Non-contact**
  Measures through the air without touching the target object, at relatively large distances.
- **Object Ranging**
  Object distance is measured rather than just the presence or proximity.
- **Distance Proportional Output**
  The sensor's outputs are proportional or related to the measured target range.
- **High Resolution**
  Precise discrimination of target position.
- **Unaffected by Target's Optical Characteristics**
  The sensor's operation is not sensitive to ambient light levels, the color of the target, or target is optically transparency/reflectivity.
- **Sensitive**
  Detects large and small objects.

Typical Applications



Level Measurement

Measure the level of liquid or solid materials in tanks or bins, for inventory or batching.

Dimensioning

Determine the size of an object for information or to determine its volume or width.

Web Break

Rapidly detect a broken web in a printing press or paper machine.

Roll Diameter

Measure the size of a roll to control tension or speed, or determine full/empty status.

Proximity

Determine the presence of objects to count or control their movement.

Sort/Select

Sort or select objects based on differences in their physical dimensions.

Loop Control

Precisely control the position of material loops from wires to large webs.

and many more...

Getting Started

Unpacking

Check that you received the following items:

- Circuit board
- Ultrasonic transducer with connecting cable attached
- This manual

Specifications

Circuit Board	
Power Input	12-24 VDC @ 40 ma.
Range	Fixed, 6 to 60 inches
Output	0 to 10 VDC, Linear where 0 VDC = 6 inches 10 VDC = 60 inches
Resolution	0.060 inches
Temperature	0 to +70 C (32 to 160 F)
Humidity	5-95%, non-condensing
Measurement Period	50 mSec (20 Hz update)
Interface connections	Terminal Block
Transducer connection	2-pin Molex
Weight	1.6 oz.
Size	2.85L x 1.85W x 1.25H

Transducer	
Type	Electrostatic Ultrasonic
Frequency	50 kHz
Beam Shape	Conical
Beam Angle	15 degrees total @ 3db down
Temperature	-30 to +70 C (-20 to +160 F)
Board Connection	Blade terminals
Size	1.69" diam. x 0.5" deep
Weight	0.3 oz.

Mounting

Ultrasonic transducer

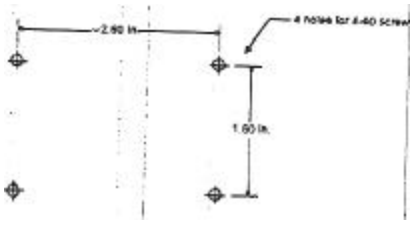
The transducer mounts in a 1.54" diameter circular hole cut into any sheet material. The transducer can be glued using a resilient compound such as GE Silicone Sealant.

Grounding

If the sheet material is metal, surface contact to the transducer will connect the surface to the sensor's ground (DC-). This is allowable as long as it doesn't conflict with other wiring.

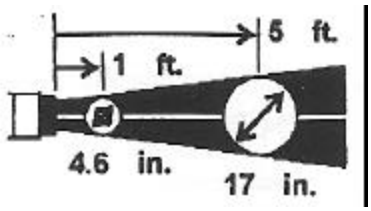
Circuit board

The circuit board mounts on 4 standoffs using 4.40 screws in the following hole pattern:



Beam Pattern

The beam pattern is conical with a total angle of about 15 degrees. The cone starts at the face of the sensor at about 1.5 inches in diameter and grows from there as shown in the diagram below. The beam pattern is approximate, and represents the



boundary where the return echos are 3 db down.

Orientation

The transducer orientation should be perpendicular to the target object for best results. The sensor will loose the target if the ultrasound energy is reflected away from the transducer rather than back to it. Curved or spherical objects make good targets. Make sure other unintended targets are not visible to the sensor.

Connections

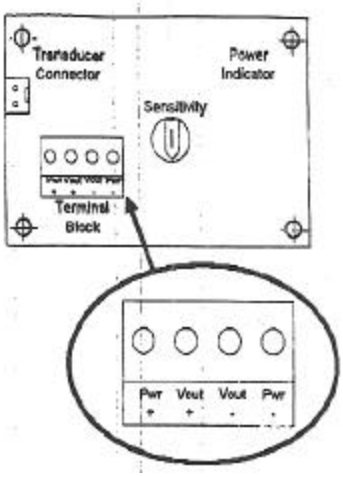
Ultrasonic transducer

The ultrasonic transducer is provided with a cable attached. Connect the transducer cable (2-pin brown female Molex connector) into the mating *Transducer Connector* on the circuit board.

The two BLADE terminals press onto mating terminals on the transducer. The shield end (ground) should be attached to the terminal of the transducer's outer shell, placing the outer shell at ground potential.

Power Input

Connect a +12 to 24 volts DC power supply via the ***PWR*** + and ***PWR-*** terminals of the *terminal block*. Do not connect the power backwards or damage to the system will result. As soon as you apply power, the *Power Indicator* will light and the transducer will begin clicking repetitively.



Voltage Output

The system supplies a 0 to 10 volt DC output that is proportional to the distance 6 inches to 60 inches. This output is available on the ***Vout+*** and ***Vout-*** terminals of the *terminal block* as shown in the above drawing.

Targets closer than 6 inches will result in a 0 volt output and targets farther than 60 inches a 10 volt output.

If no target is detected by the sensor, the output will be the same as a near target (0 VDC).

Operation

Starting the sensor

Following installation and connection according to the preceding sections, the sensor starts running as soon as the DC power is applied.

When the sensor is running the *Power Indicator* should be ON and a repetitive clicking heard from the transducer.

Distance Calculation

The sensor's measured distance is represented by the voltage set between the *Vout-* and *Vout+* terminals of the terminal block. A meter or other monitoring device can be wired to these terminals. The following table gives the voltage vs. distance.

Inches	Voltage	Inches	Voltage
6	0.0	34	5.2
7	0.2	35	5.4
8	0.4	36	5.6
9	0.6	37	5.7
10	0.7	38	5.9
11	0.9	39	6.1
12	1.1	40	6.3
13	1.3	41	6.5
14	1.5	42	6.7
15	1.7	43	6.9
16	1.9	44	7.0
17	2.0	45	7.2
18	2.2	46	7.4
19	2.4	47	7.6
20	2.6	48	7.8
21	2.8	49	8.0
22	3.0	50	8.1
23	3.1	51	8.3
24	3.3	52	8.5
25	3.5	53	8.7
26	3.7	54	8.9
27	3.9	55	9.1
28	4.1	56	9.3
29	4.3	57	9.4
30	4.4	58	9.6
31	4.6	59	9.8
32	4.8	60	10.0
33	5.0		

Tho distance can be calculated from the voltage output as follows:

$$\text{Inches} = (V * 5.4) + 6$$

The voltage output changes from 0 VDC at 6 inches to 10 VDC at 60 inches.

Performance

Update Rate

The sensor measures distance repetitively at an interval of approximately 50 milliseconds. This is the interval between the "clicks" heard from the transducer. After each measurement, the analog output is updated.

Target Considerations

The target must reflect the ultrasound energy back to the sensor. Sensor performance will be affected by the strength of the "echo". Flat surfaces are best when perpendicular to the beam direction. Curved surfaces are generally good targets because a portion of the energy is generally reflected directly back to the sensor. Low density materials including some foams, cloth and powders may exhibit reduced detection range, or can absorb or be transparent to ultrasound. In many cases these materials are easily detected, so testing a material sample is recommended. Increasing the sensor's gain using the sensitivity adjustment may be required.

Temperature Effects

The most significant factor that affects measurement accuracy is temperature. At room temperature, a change of 10 degrees will result in approximately 1% change in the speed of sound and therefore the same change in the distance output. This model sensor does not compensate for temperature affects.

Precautions

- Keep unintended targets from transducer's field of view. Keep the beam pattern in mind.
- Keep transducer away from ultrasonic noise sources, such as pressurized air nozzles

Adjustments

Sensitivity

This adjusts the electronic sensitivity to the strength of the ultrasonic echo being returned from the target object. Very small or sound absorbing targets may not send a very strong echo and therefore may require increased sensitivity for stable detection. The sensitivity potentiometer is located next to the terminal block on the solder side of the circuit board. The unit is shipped at mid range and in general it does not require adjustment. Sensitivity can be increased by rotating the potentiometer clockwise and decreased counterclockwise rotation. Full rotation of the pot is 180 degrees.

Ultrasonic Tuning Adjustments

The ultrasonic tuning adjustments consist of a transformer T1 (silver case) and inductor L1. These generally do not require adjustment unless the cable length to the transducer is lengthened.

To adjust these components:

1. Put an oscilloscope probe on test point TP1 and set the scope to trigger on the transmitted pulse. This test point is a hole in the PCB that is labeled on the component side of the board.

2. Using delayed sweep, monitor a target echo signal and adjust T1 for maximum amplitude.

3. Using the same signal as in step 2m, adjust L1 for maximum amplitude.

Voltage Calibration

Potentiometer R22, located on the daughterboard of the main circuit board, calibrates the 10.0 volt output at the maximum target range. Point the sensor at a target greater than 60 inches to view the maximum voltage out and adjust R22 if required.

In Case of Difficulty

Basic Checkout

With DC power applied to the sensor the Power Indicator should be ON and a clicking sound should be heard from the ultrasonic transducer.

If the Power Indicator is not ON check the power connections. **Applying power in reverse polarity can damage the unit!**

If the Power Indicator is ON but the sensor is not clicking, check the cable connections between the circuit board and ultrasonic transducer. Look for broken or shorted wires or loose connectors.

Common Problems

Output stuck at 0 VDC

1. An object is near the front of the sensor that is being detected, possibly associated with the mounting arrangement.

2. The sensor is "self-detecting" its own transmit signal. Reduce the sensitivity to turning the Sensitivity adjustment counterclockwise.

3. No target is being detected. Place a target in front of the transducer at a known distance and test for a reasonable voltage value

Repairs and Returns

If you need to discuss a problem or return a unit please call the following number for technical support:

Jameco Electronics
800-831-4242

Jameco Part number 134105

Senix FAX

Date *1 October, 1996*

Number of pages including cover sheet 9

TO:	Chris Shaffer Amdt Electronics 1355 Shoreway Blvd Belmont, CA 94002	***FROM:***	***Senix Corporation*** *Doug Boehm* *52 Maple Street* *Bristol, VT 05443 U.S.A.*
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		e-mail	*Infosenix.com*

CC:

REMARKS: [ ] *Urgent* [X] *For your review* [ ] *Reply ASAP* [ ] *Please Comment*

Chris,

Attached is a draft copy of the User Guide for the ultrasonic sensor in the upcoming Jameco catalog. Note that we have changed the sensor's range from 4-60" to 6-60".

Please FAX back any comments or corrections. Thanks

Doug Boehm

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